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AUTHOR(S):

HIRASAWA, YASUSUKE; ODA, RYONOSUKE; NAKATANI, KATSUYA

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Nerve Injury Associated with Fracture in Upper Extremity

YASUSUKE HIRASAWA, RYONOSUKE ODA, KATSUYA NAKATANI,

Department of Orthopaedic Surgery, Kyoto Prefectural University of Medicine
(Director ; Prof. Dr. TAKEFUMI MOROTOMI)

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Introduction

Fracture is one of the most common cause of peripheral nerve paralysis. According to our recent study[2], pripheral nerve injury was associated with fracture in 10.9 per cent. Although it has been reported[1,3,4,5] that nerve injuries caused by fracture are relatively benign, it has been a recurrent theme how long we should wait for spontaneous recovery or when we should secure recovery by surgical intervention.

In this paper, we intended to analyse the nerve injuries associated with fracture, reviewing the characteristics of these injuries in the upper extremity.

Clinical Materials and Methods

A statistical study on peripheral nerve injury has been done at our clinic for 11 years' period from May 1, 1963 to April 30, 1974. Among 597 cases of the nerve injuries treated at authors' clinic during this period, 65 cases of the nerve injuries were related to fracture directly or indirectly in upper extremity.

There was a close correlation between the injured nerve and the fracture site (Table 1). Included were 34 injuries to the radial nerve, 7 to the median nerve and 24 to the ulnar nerve. There were three times as many as females in this series (Table 2).

Analysis was done on type of nerve paralysis, characteristics of individual nerve paralysis and results of treatmen.

Results

1) Type nerve paralysis

The nerve injury associated with fracture was classified into the three types. 1) primary type is paralysis arisen immediately after fracture. 2) secondary type is paralysis

Key words : peripheral nerve injury, fracture
Present address : Yasusuke Hirasawa, Department of Orthopaedic Surgery, Kyoto Prefectural University of Medicine, Kawaramachi-Hirokoji, Kamigyo-ku, Kyoto, 602, Japan.

Table. 1. Nerve Injury and Fracture Site

Fracture	Nerve			Total
	Radial	Median	Ulnar	
Humerus				
Neck	1	0	0	1
Shaft, Middle	5	0	0	5
Shaft, Dist, 1/3	15	0	0	15
Supracondylar	6	2	11	19
Lat, Epicondyle	1	0	4	5
Med, Epicondyle	0	0	4	4
Radius & Ulna	6	4	5	15
Carpal Bones	0	1	0	1
Total	34	7	24	65

Table 2. Nerve Injury and Fracture in Upper Extremity

Nerve	Male	Female	Total
Radial Nerve	27	7	34
Median Nerve	7	0	7
Ulnar Nerve	15	9	24
Total	49	16	65

Table. 3. Types of Nerve Paralysis

Primary Type : Paralysis Arisen Immediately After Injury
Secondary Type : Paralysis Arisen During Fracture Treatment
Delayed Type : Paralysis Developed More Than Several Months After Injury

Table. 4. Types of Nerve Paralysis

Nerve	Primary	Secondary	Delayed	Total
Radial	22	12	0	34
Median	6	1	0	7
Ulnar	10	0	14	24
Total	38	13	14	65

Table. 5. Radial Nerve Paralysis and Fracture

Fracture	Primary	Secondary	Total
Humerus			
Neck	1	0	1
Shaft, Middle	2	3	5
Shaft, Dist, 1/3	8	7	15
Supracondylar	6	0	6
Lat, Epicondyl	1	0	1
Radius & Ulna	4	2	6
Total	22	12	34

arisen during the treatment, such as the closed or open reduction of the fracture. 3) delayed type is a paralysis developed more than several months after injury (Table 3).

65 cases of paralysis consisted of 38 primary types, 13 secondary types and 14 delayed types. It is interesting that 12 cases among 34 radial nerve injuries were of secondary type and 14 cases among 24 ulnar nerve injuries were of delayed type (Table 4).

2) Radial nerve paralysis and fracture

15 cases of the radial nerve injury were caused by the fracture of one-third distal site of the humerus (Table 5).

Case #1 ; A 23 year-old male was involved in the motor car accident, and had a fracture of right humerus (Figure 1). He developed a typical radial nerve paralysis at the injury. On surgery, the radial nerve appeared to be compressed by the fragment of the fractured humerus (Figure 2). Immediate open reduction with intramedullary nail gave an excellent result of return of function in one month.

Case #2 ; A 44 year-old male developed radial nerve paralysis immediately after the plate fixation for the fractured humerus, which was done at elsewhere hospital (Figure 3). Although he had low frequency therapy for 3 months, he had no sign of return of function and was transferred to our hospital.

Fig. 1. Case #1 Roentgenological finding of right humerus.

Fig. 2. Case #1 At surgery. Radial nerve, which was compressed by a bone fragment.

Fig. 3. Case #2 At surgery. Radial nerve, which was compressed by a plate.

He had an excellent result by neurolysis and sheathing with fibrin membrane, at 6 months after surgery.

Case #3 ; A 13 year-old female had a fracture of left humerus by falling down from the stone steps at the shool excurtion. She had an open reduction at elsewhere hospital. She developed radial nerve palsy immediately arter surgery and was transferred to our hospital. At surgical exploration, the radial nerve was found to be fixed with metal wire (Figure 4). By end to end suture, after the removal of nectrotic part of the nerve, she had an excellent return of function in one year after surgery.

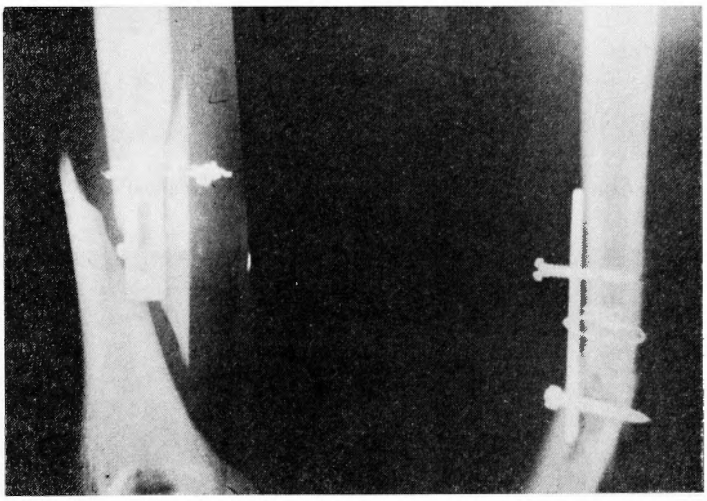

Fig. 4. Case #3 Roentgenological finding of left humerus.

3) Median nerve paralysis and fracture

4 cases among 7 median nerve injuries were caused by the fracture of the forearm, suchas Colles' fracture (Table 6).

Table. 6. Median Nerve Paralysis and Fracture

Fracture	Primary	Secondary	Total
Supracondylar	2	0	2
Forearm	3	1	4
Carpal Bone	1	0	1
Total	6	1	7

Case #4 ; A 19 year-old male fell down from the motor bike. He had painful wrist with numbness over the median nerve region. He was found to have a compression nerve paralysis of median nerve by fracture dislocation of he carpal bone (Figure 5).

Case #5 ; A 9 year-old male was noticed to have median nerve paralysis by the supracondylar fracture (Figure 6). He had been treated conservatively for ten days, when he developed severe circulatory disturbance. He had no pulse of radial artery at wirst. Immediate surgical exposure was done. Neurolysis of the median nerve and the thromboectomy were done, with an excellent results.

4) Ulnar nerve paralysis and fracture

19 cases of the ulnar nerve injury were caused by the fracture of the distal end of the humerus (Table 7).

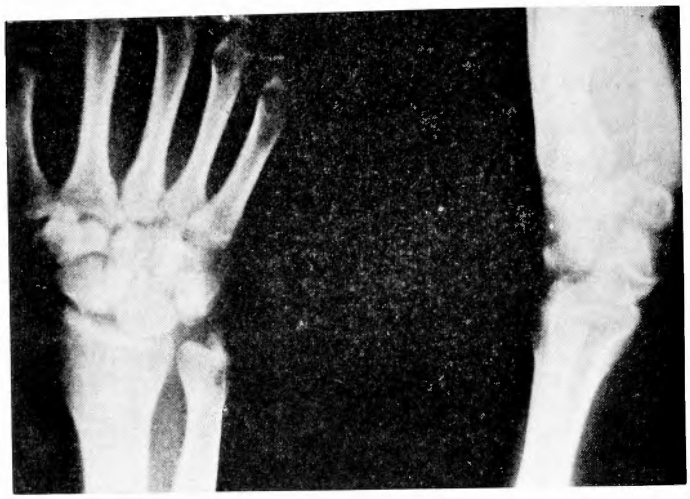

Fig. 5. Case #4 Frature dislocation of carpal bone.

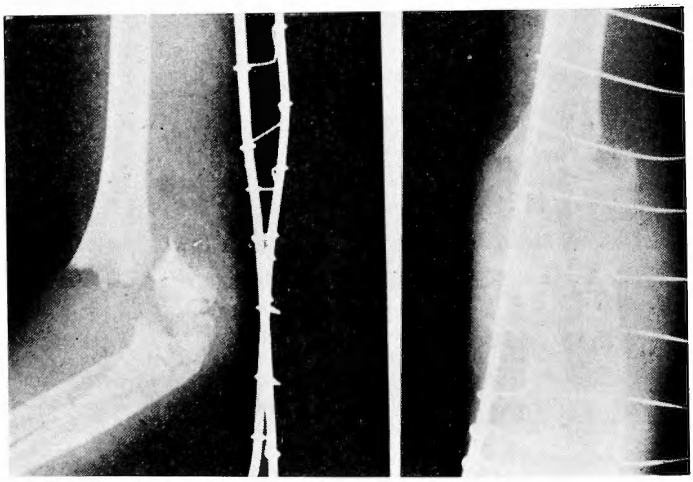

Fig. 6. Case #5 Roentgenological findings. Supracondylar fracture.

Table. 7. Ulnar Nerve Paralysis and Fracture

Fracture	Primary	Delayed	Total
Supracondylar	3	8	11
Lat, Epicond.	0	4	4
Med, Epicond.	2	2	4
Forearm	5	0	5
Total	10	14	24

Case #6 ; A 32 year-old male developed severe muscle atrophy with hypoesthesia by ulnar nerve palsy, since 2 month ago. He had an epicondylar fracture at 5 years old, with valgus deformity of the elbow (Figure 7). Anterior transfer of the ulnar nerve was done with fair result.

5) Results of the conservative and surgical treatments

According to the criteria based on the British Nerve Injury Committee, a follow-up study was done on 44 cases of the paralysis (Table 8).

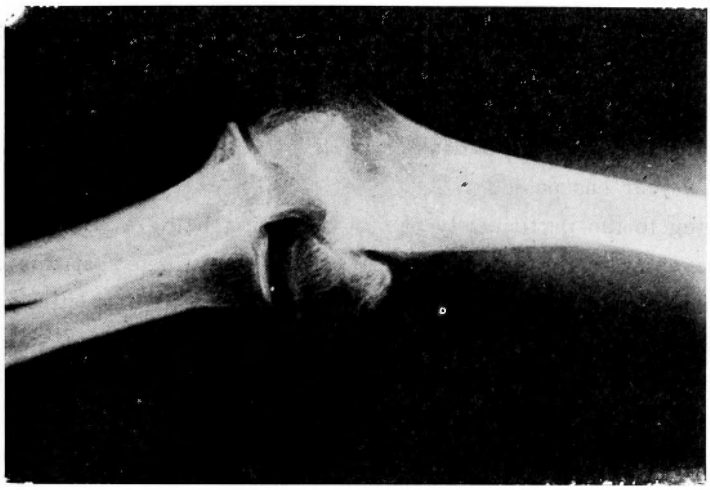

Fig. 7. Case #6 Roentgenological findings. Old epicondylar fracture.

Table. 8. Clinical Evaluation Method

Excellent	: Complete recovery, or $M_{4,5}$, $S_{3^+,4}$
Good	: Almost recovered subjectively, with Slight Abnormality by objective examination (E.M.G., etc.). M_3, $S_{2+,3}$, or 2 degrees Improved.
Fair	: Slight improvement, M_2, S_2, or I degree improved.
Failure	: No improvement, or worse. $M_{0,1}$, $S_{0,1}$

Based mainly on Nerve Injuries Committee of the British Medical Research Counil.

Table. 9. Result of Conservative Treatment

Result	Nerve			Total
	Radial	Median	Ulnar	
Excellent	4	0	0	4
Good	5	1	3	9
Fair	4	1	2	7
Failure	1	0	1	2
Total	14	2	6	22

Table. 10. Result of Surgical Treatment

Result	Nerve			Total
	Radial	Median	Ulnar	
Excellent	5	1	1	7
Good	2	0	3	5
Fair	3	2	4	9
Failure	0	0	1	1
Total	10	3	9	22

Twenty two cases of the paralysis were treated conservatively. 59% were good and excellent by conservative treatment (Table 9).

Other twenty-two cases were surgically treated. 55% were good and excellent by surgical treatment (Table 10).

Discussion

According to the statistical study of 597 cases of the nerve paralysis by authors[2], conservative treatment produced good or excellent recovery in about 50 percent of the patients. Those in whom the treatment was begun within a month after injury displayed a higher rate of improvement, whereas the prognosis in those placed upon conservative treatment after a lapse of more than three months following injury tended to be poor. Of

patients surgically treated, approximately a half received neurolysis and those given neurorrhaphy as well showed gratifying therapeutic results. The data obtained indicate that a favourable recovery may be expected in a patient receiving surgical operation within three months after injury and that the outlook is liable to be poor if the patient is operated on after more than a year has passed.

Possibly owing to the particularity of our institution being a university-affiliated hospital, many of the cases in the present investigation were treated at this department after considerable amounts of time following injury ; hence a trend to relatively poor prognosis.

The paralysis of the nerve caused by the fracture revealed various clinical features depending upon the mechanism of the nerve injury, such as compression, traction, adhesion and so on. Generally, the prognosis was relatively good, except the delayed type praralysis, comparing the other injuries such as open wound injuries and so on, reportedly by Seddon[6].

However, early surgical intervention appeared mandatory, when the neurotmesis was highly suspected or when the conservative therapy failed to obtain any findings of neural regeneration at the follow-up.

Summary

Among 597 cases of peripheral nerve injury treated at authors' clinic from May 1963 to April 1974, 65 cases of nerve injury were related to fracture in upper extremity.

The analytical study was done with some interesting results.

Although nerve injuries caused by fractures were relatively benign, early and timely surgical intervention was recommended when the conservative treatment failed to obtain the sign of the neural regeneration at the follow-up.

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和文抄録

上肢における骨折と末梢神経損傷

京都府立医科大学整形外科学教室

平沢泰介，小田良之輔，中谷勝也

骨折と合併せる末梢神経損傷は臨床家にとって比較的多く経験されるにもかかわらず，骨折のみに目を奪われてしまい適切な治療を行われない場合が多い．この点より著者らは上肢における骨折と末梢神経損傷ならびにその治療法についての検索を行った．

昭和38年5月1日より昭和49年4月30日までの11年間に当教室を受診した末梢神経損傷患者597名のうち，上肢の骨折と合併した末梢神経損傷は65例であり，全神経損傷の10.9%を占めていた．神経別頻度は橈骨神経損傷が34例と半数以上を占めていた．骨折別にみると上腕骨顆上骨折が19例と最も多く，次いで上腕骨骨幹部下⅓の骨折ならびに前腕骨々折がそれぞれ15例と多かった．

神経損傷の発生機転により primary, secondary, delayed の3型に分類すると，骨折手術後にすなわち secondary に末梢神経損傷の発生したものは橈骨神経に12例と多くみられ，一方 delayed type は尺骨神経損傷に14例と多くみられた．

これらを神経別にみると橈骨神経損傷では上腕骨々幹部骨折とくに下⅓の骨折が15例と約半数を占めていた．正中神経損傷をみると Colles 骨折による4例と顆上骨折による2例があり，特殊な例として月状骨を中心とする手根骨脱臼骨折と合併した麻痺が1例みとめられた．尺骨神経損傷をみると primary 10例と比較的少なく，遅発性麻痺が14例と全症例の約20%を占めていた．

British Method を基準として follow-up できた44症例について予後調査を行うと，注射麻痺などに比較して全体的に予後は比較的良いが，遅発性麻痺の多い尺骨神経損傷は予後の悪い傾向を示した．

骨折に合併する神経損傷には neurapraxia, axonotmesis が多く成績は良好であるが，完全麻痺があれば neurotmesis の可能性は強く早期の観血的検索が必要となる．しかし神経は断裂，牽引，圧迫，挫扼，癒着などの種々の機序により損傷されるために損傷状態の把握や予後の判定は困難で，保存的療法で神経再生の徴候がみられなければ，できるだけ早期に観血的療法に踏み切るべきである．